Simulated practice in healthcare: technology and educational approach

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Abstract

Recently, whether it relates to face to face or distance learning, technology has had an increasing impact on the delivery of education to learners across all disciplines. It is sometimes apparent that the focus is too often put on the technology rather than its use in a sound educational manner or how it benefits students. This article will primarily be of interest to healthcare educators as it explores the use of patient simulators and related technology in the facilitation of scenario-based simulated practice with students. The argument is that "more is not necessarily better" for the students in the sense that the most expensive or latest piece of technology does not necessarily generate better learning outcomes for the students, but may instead become a distraction taking time away from the actual learning experience. It needs to be acknowledged that it is the educators (in this case, simulation facilitators) that are the most important asset in most educational experiences as simulation technology alone has a very limited potential.

Keywords: Simulation, scenario, patient simulator, healthcare, medicine, technology, facilities, experiential learning

Introduction

The range of training tools and teaching methods available to clinical skills centres has greatly improved since the use of oranges to teach cannulation (Bowyer et al 2005). Students can now use sophisticated self-directed learning systems such as the Laerdal Virtual I.V.™ (Intra Venous) trainer which uses a mixture of screen-based interactive simulator with a haptic device to simulate the insertion of a cannula into a human hand or arm (Bowyer et al 2005). In the last few years there has been an emphasis on the provision of more realistic simulated clinical practice experiences to students in an attempt to make them better and safer healthcare practitioners. Nowadays, 'simulation' in healthcare education has almost become synonymous with technology. The advancement of technology has enabled the commercialisation of ever more sophisticated and realistic training tools, such as surgical and computer-controlled patient simulators. These can play a very important role in the students' acquisition of technical and non-technical skills to improve patient safety. Technical skills refer, for example, to the performance of clinical procedures while non-technical skills cover aspects such as decision making, teamworking, and situation awareness (Fletcher et al., 2002), which can also be referred to as cognitive and social skills (Flin and Maran, 2004).

The use of simulation as an educational strategy has been encouraged by a number of factors such as more advanced and affordable simulation products (Alinier, 2007b), the publication of official reports recommending the use of simulation for initial training and Continuing Professional Development (Department of Health, 2006, Department of Health, 2008a, 2008b, Chief Medical Officer, 2009, Nursing and Midwifery Council, 2007) and the inerrant competitive nature of the Higher Education sector whereby Universities are trying to attract the best students by impressing them with the resources they have on offer.

From low to high-fidelity simulation and simulators

The use of simulation technology is often supplemented by a sophisticated audio and visual (AV) installation (Seropian, 2003, Alinier, 2008b, Goodrow et al 2008) to link a fully equipped simulated clinical environment with a control room and an observation room. The overall setup creates what is called a “simulation centre” (Alinier, 2008a, Hwang and Bencken, 2008, Alinier, 2007a) and allows students to learn, in turn, in an active or a passive way, depending on whether they are taking part in a scenario or remotely observing their peers. They differ from clinical skills centres (Ledingham and Harden, 1998, Bradley and Postlethwaite, 2003) in the sense that they are designed for students to put their skills into practice in a student-lead scenario-based learning activity, which is often called “high-fidelity simulation” training (Issenberg et al 2005, Issenberg and Scalese, 2007), as opposed to an environment where students learn all together and at the same time to master individual clinical skills out of context and under the instructions of a tutor, which would then be called “low-fidelity simulation” (Alinier, 2007b).

There is in fact a justifiable educational continuum from low to high-fidelity (Maran and Glavin, 2003) showing that both approaches are not mutually exclusive, but complementary as they foster the development of competencies and good professional practice. As identified 10 years ago, with the emergence of simulation technology and methodologies, the activities of many clinical skills centres have diversified (Dent, 2001). Although the facilitation of contextualised simulated learning is more the specialty of simulation centres, many skills centres also provide some learner-centred educational opportunities using simulated patients or patient simulators, and whereby students are allowed to make mistakes without detrimental consequences to real patients.

Having introduced the concept of fidelity with regards to simulation, it is probably worth demystifying the terminology of the patient simulator, or the “tool”. Low-fidelity simulation tools include training aids such as the cannulation arm which primary function is to act as a practice medium for the mastery of the cannulation technique, mainly a psychomotor skill. An area where there is a lot more confusion is for people to differentiate between medium or intermediate-fidelity and high-fidelity patient simulators. The key differences lie in the physiological modelling and compatibility with real clinical equipment of the patient simulator. High-fidelity patient simulators are said to be “model-driven” (Maran and Glavin, 2003) whereas an intermediate-fidelity patient simulator would be mainly operator driven. Similarly, physiological signals from a high-fidelity patient simulator can be captured by real clinical monitoring equipment, whereas an intermediate fidelity patient simulator would interact with an emulated monitor whose data is primarily determined by an operator. In both cases, these more or less interactive patient simulators offer an interesting range of training capabilities which suit most healthcare professionals’ training needs (Airway features, spontaneous breathing, voice, auscultation sounds, ECG output, palpable pulses, blood pressure, venous system…) (Alinier, 2007b).

To summarise this section it can be said that “simulation” refers to the educational approach while “simulator” refers to the tool being used. The degree or level of fidelity of the educational approach is about the way the overall learning experience is facilitated to engage the students in a realistic scenario, while the fidelity of the tool is highly dependent on its sophistication and interactivity to allow it to run in a more or less autonomous way by responding to the treatment it receives and medication administered.

Figure 1: The tutor on the left controls the physiological parameters of the intermediate-fidelity patient simulator (Laerdal SimMan™), its voice by speaking in a microphone, as well as the position of the networked digital cameras (Scotia SMOTS™) for retransmission in the observation room for other students. The tutor on the right hand side is currently responding to a phone call from one of the students in the simulation room.

Technology calling for further technology

As reported earlier, simulation may involve the use of sophisticated and interactive computer controlled patient simulators which allow for contextual inter-professional teamwork training through the exposure to realistic clinical scenarios (Beaubien and Baker, 2004). Such devices are in themselves a technological bundle with various sensors, interface and communication systems which give them a duality of being very human like while also being very different at the same time. While they are externally able to recreate many physiological parameters expected from real patients, they are still very far from possibly being mistaken for human beings. The technology ensures that the students’ actions do not need to be triggered by verbal cues from the tutors, but instead require students to perform a correct patient assessment as they would have to do with real patients (Alinier, 2007b).

In order to enhance the realism of the experience for the students actually involved in any scenario, it has become the norm for simulation centres to be equipped with an advanced camera recording system for recording and live transmission into other rooms. This allows the tutors to remotely operate the patient simulator and other aspects of the scenario while controlling its voice to respond to the student's questions if required (Figure 1). It also enables supernumery students to watch their peers without causing any distraction hence allowing scenario participants to concentrate more on the scenario (Alinier, 2007b). Although the seemingly passive learning experience of the students who are scenario observers has not been thoroughly studied yet, students report that it allows them to reflect on their own practice as they have the opportunity to observe patient care interactions from a different perspective.

Figure 2: Group of students remotely observing a scenario and who have noticed that the patient is becoming acutely unwell due to a lack of situation awareness on the part of the scenario participants, and hence delayed treatment.

Observers strongly engage in the experience lived by their peers taking part in a scenario as demonstrated by the students expressions in Figure 2. Provided, the students have the appropriate skills and knowledge to tackle the scenarios, the mix of the technology and educational approach used allows tutors to give students full control of the situation with regards to the treatment they provide to the patient simulator without the danger to cause any arm to a real patient. If the scenarios involve participants from different disciplines it allows for realistic interprofessional interaction whereby the students' teamworking abilities can be put to the test.

Another form of technology often used during high-fidelity simulation training are more or less advanced communication systems such as walkie-talkies or radios. These are used when one or more actors are immersed among the students within a scenario as another healthcare worker or patient relative. This allows them to receive specific instructions as to the progress of the scenario and what they should or should not do to “help”, be obstructive, provide specific information to the students, or resolve technical issues in a discreet manner. Such a role is often vital to direct a scenario towards particular predetermined learning objective (Alinier, 2010).

Simulation without all the technology

In the absence of an AV installation it is still possible to run fairly realistic scenarios for students by trying to create a physical barrier between the simulation space and the control area (Figure 3). This allows the same approach to be used with regards to letting students control the scenario rather than allowing the tutor to take physical control of the situation. Similarly, many scenarios lend themselves to not requiring the purchase of a patient simulator whose value may be anything between the price of a mid-range car to a small apartment. Instead the use of an actor, often called a simulated patient (Wind et al., 2004) might be more appropriate for scenario focusing on communication skills. It is also possible to complement actors with various forms of part-task trainer to offer what is called an hybrid simulation experience. This could be the use of a surgical simulator alongside a patient simulator in an operating theatre scenario (Dutta and Krummel, 2006), a sigmoidoscopy simulator or a basic part-task trainer with a simulated patient (Black et al., 2006, Kneebone et al., 2007, Kneebone et al., 2004, Taniguchi et al., 2008))(Kneebone et al., 2002).

Figure 3: Group of tutors controlling a patient simulator behind a set of partly closed mobile partitions within a clinical skills centre (ASPiH/Laerdal SimSkills course, July 2010, Queens Medical Centre, Nottingham).

Where is the evidence?

Simulation centres have appeared throughout the country with the best intentions but are they providing value for money in educational terms? The transferability of the various skills acquired by students through simulation to real practice is still unfortunately too often only supported by anecdotal stories, even if our common sense tells us that it must be a valuable learning experience as “practice makes perfect”. There is now some encouraging and growing evidence that simulated practice using more or less sophisticated models and training devices are beneficial to the acquisition of skills required by healthcare students, but also for the maintenance of some less commonly used skills by qualified healthcare professionals. Several studies have been conducted to evaluate the benefits of different simulators or part-task trainers in the acquisition of a range of skills by trainees (St Clair et al., 1992, Roberts et al., 1997, Owen and Plummer, 2002). The vast majority of such studies demonstrate the added value of such training methods and what students think about it. Although very subjective, their views are generally extremely positive, regardless of the type of approach used as their perception is often more influenced by their rapport with the educators rather than how much they have actually learnt from the experience. Research funded by the British Heart Foundation (Grant number Edcomm/Oct98/9d) at the University of Hertfordshire has shown that the use of scenario-based simulation experience is indeed beneficial in improving undergraduate nursing students’ skills (Alinier et al., 2006) but translation into real clinical care practice is more difficult to demonstrate. More recent studies related to the effect of simulation-based training on direct patient care are starting to show positive outcomes. Some of the best evidence currently relate to reduction in catheter related blood stream infections (Barsuk et al 2009), reduction in low 5-minute Apgar scores and hypoxic–ischaemic encephalopathy (Draycott et al 2006), and improved management of shoulder dystocia (Draycott et al 2008) following a simulation-based educational intervention.

How does it work best?

The educational approach with which simulation training tools are used is more important than the tool itself. To provide a beneficial learning experience to students, the patient simulator needs to be used appropriately, that is accordingly to the level of experience of the students, in a friendly and supportive atmosphere. They need to be oriented to the functionality of the simulator, the equipment, and the environment before the scenarios. Students also need to be briefed about the overall concept of simulated practice in terms of our expectations of their actions and behaviour during the scenarios. Following each scenario, the debriefing of the students’ learning experience needs to be facilitated in an appropriate manner (Kuiper et al., 2008, Leigh, 2008). These are some of the things the technology cannot do by itself but requires trained simulation specialists to facilitate (Issenberg, 2006). As highlighted in an article by Alinier et al. (2005): “The major problems that have to be faced regarding the adoption of such technology are the financial commitments incurred by the equipment itself and its adequate use by lecturers or trainers. Teaching using realistic simulation requires a different approach to traditional clinical skills teaching for example. The use of advanced mannequins may also require computing skills not available within the team of lecturers wanting to make use of the technology and therefore require additional technical support and training (Bradley and Postlethwaite, 2003). If time is not a significant factor in the implementation of simulation training, minimal institutional support and appropriate training of staff can progressively enable the development and efficient use of such technology in a nursing curriculum. The environment in which the patient simulator is setup, along with the medical equipment surrounding it, is also a key element in the delivery of realistic simulation training sessions, and can incur major additional costs. However we believe that even with a limited budget it is possible to create and acquire the resources needed to expose nursing students in an effective way to simulation training. Working towards the development of a sophisticated and specialised training laboratory at low cost requires the use and development of in-house resources in all possible aspects". As an alternative solution, collaboration of a group of institutions or users can be particularly interesting in terms of costs sharing, especially in the initial stages of development and acquisition of expertise in simulation-based education (Alinier et al., 2005, Driggers and Shaver, 2005, Seropian et al., 2007). Key to the success of an effective and sustainable implementation of simulation training is a mix of skills and attributes from the team involved in the development, which include dedication, enthusiasm, collaboration, and networking. A valuable starting point is look at what the existing multidisciplinary communities have achieved and to learn from their expertise. The key groups in this domain are:

- The Association for Simulated Practice in Healthcare (http://www.aspih.orrg.uk)

- The Society in Europe for Simulation Applied to Medicine (http://www.sesam-web.org)

- The Society for Simulation in Healthcare (http://ssih.org)

- The Australian Society for Simulation in Healthcare (http://www.sdc.qld.edu.au/assh.ht)

Conclusion

It can be easily argued that, even with the greatest technology, someone's poorly informed educational practice could be more detrimental than beneficial to students. It is more the educators rather than the technology that matters when it comes to facilitating simulation-based education. Simulation is a whole package whose main contributors to the success of the learning experience are the facilitators rather than the tool or technology. Investment in technology is only valuable and cost-effective if it is to be appropriately and intensively used. High-fidelity simulation education requires the adoption of a different teaching approach from basic clinical skills or Advanced Life Support training to engage the students and help them behave as they would in a real situation so they can learn from the experience. Educators interested in providing simulated practice experiences to their students need to engage with the existing healthcare simulation communities to benefit from the knowledge and experience of their members.

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